Shape coexistence in the neutron-deficient lead region

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Nuclear spectroscopy group

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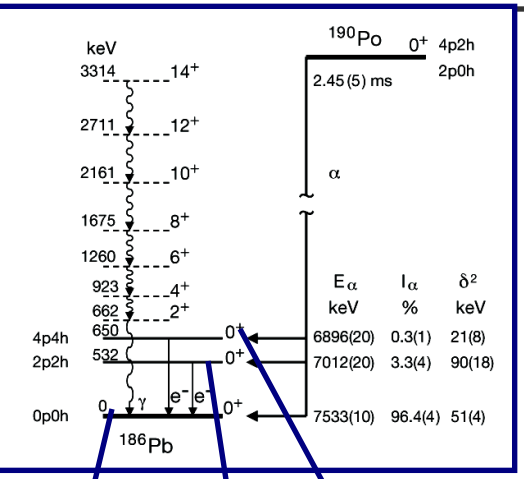
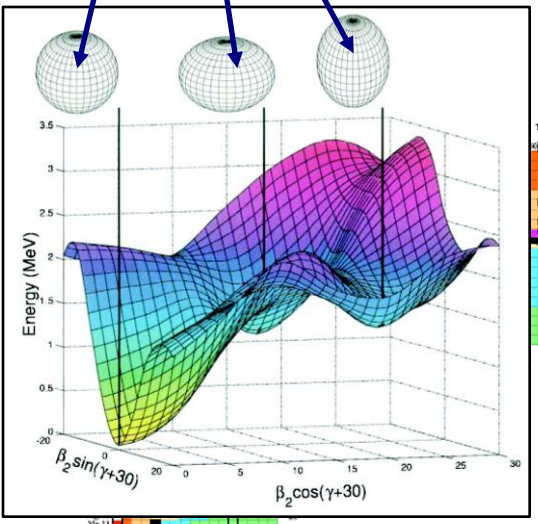
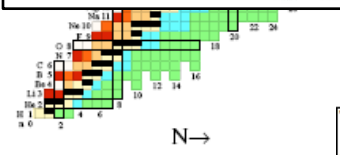
Content

- Physical motivation
- Experimental set-up
- Coulomb excitation of ^{182,184,186,188}Hg
- Conclusion and future perspectives

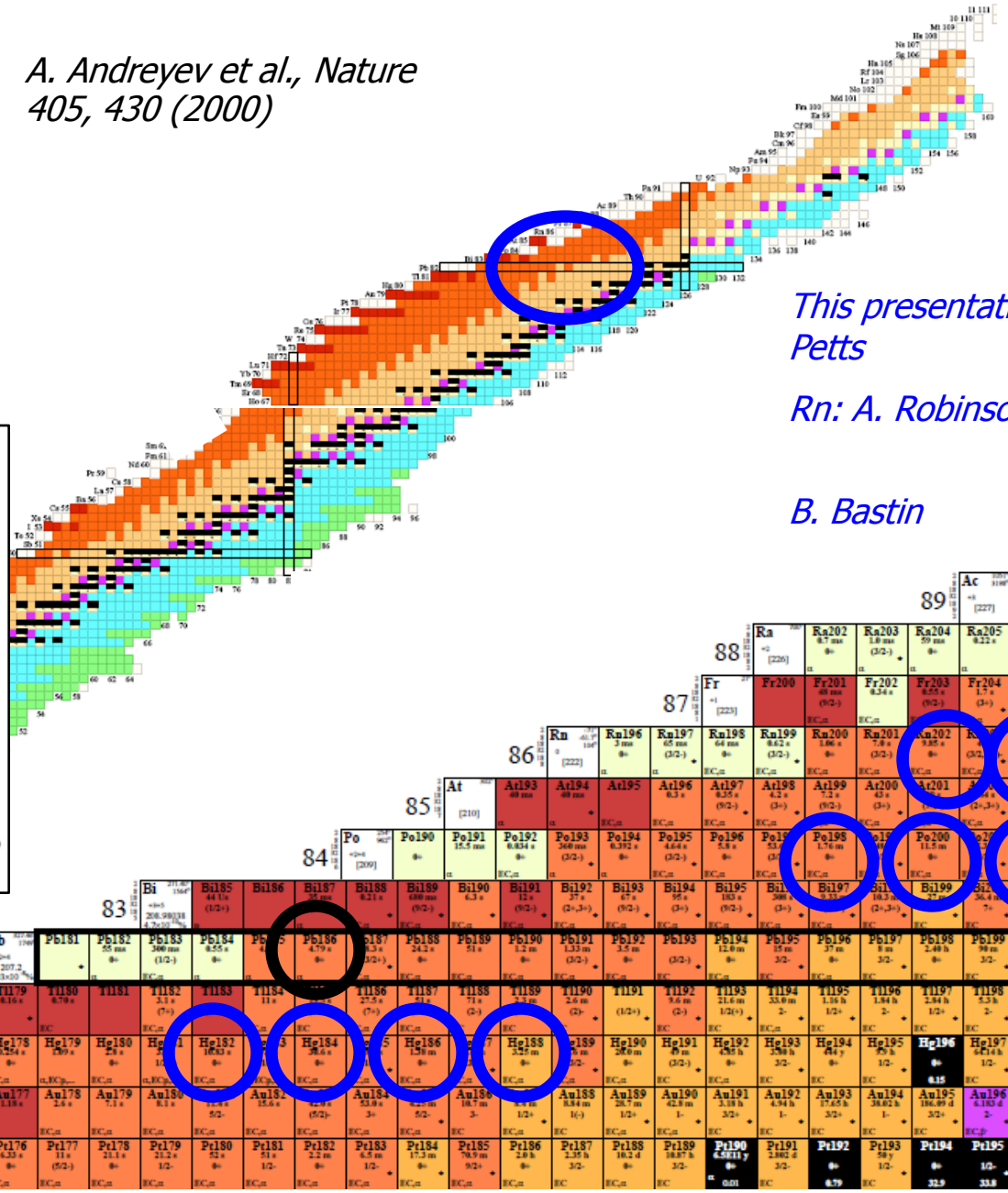
Physical Motivation







A. Andreyev et al., Nature 405, 430 (2000)

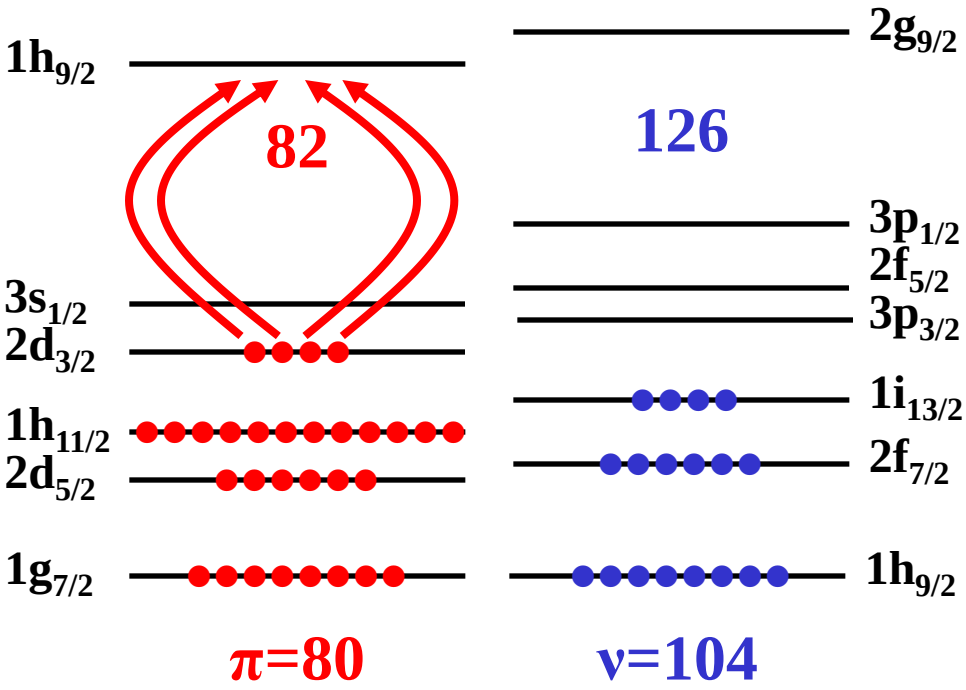


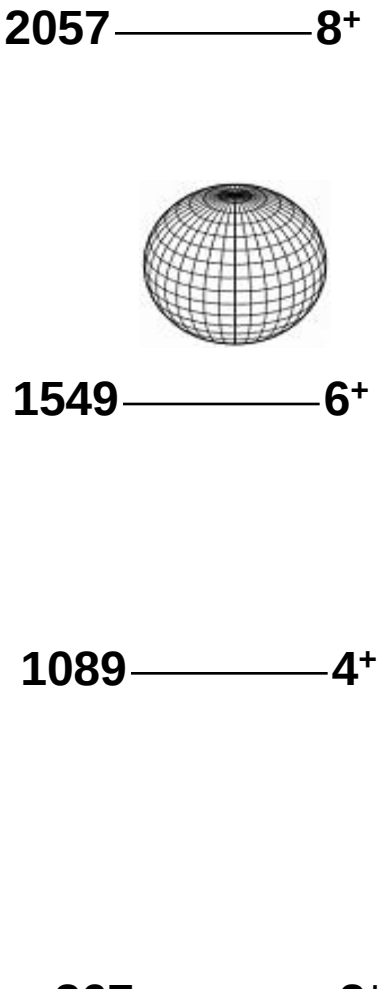
This presentation: N. Bree, A. Petts

Rn: A. Robinson

B. Bastin

Physical Motivation





^{184}Hg

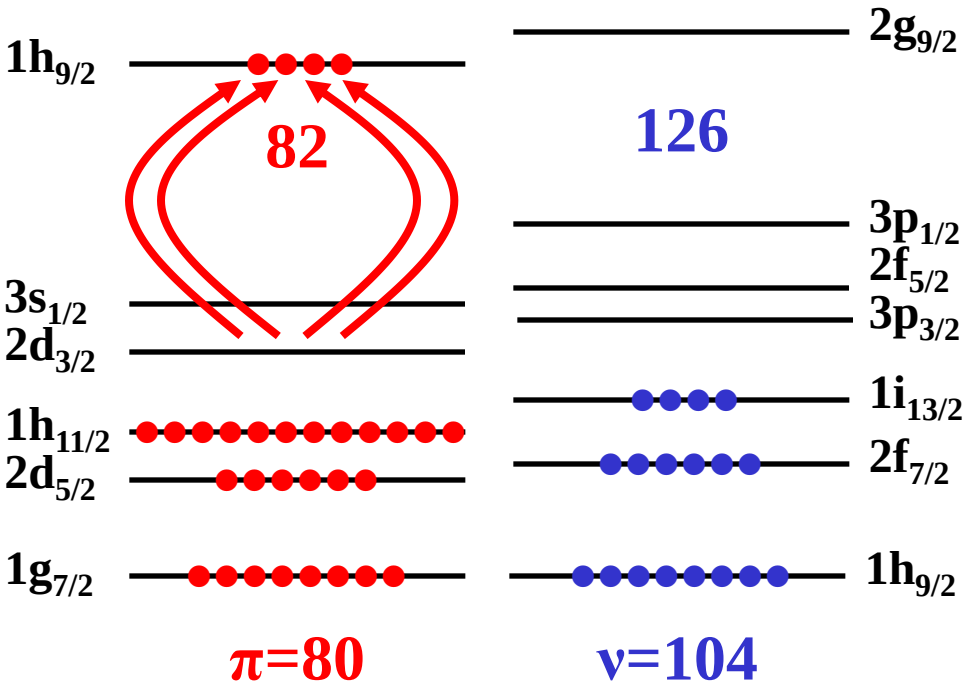
shell model: π0p2h states

mean-field approximation:

slightly oblate

J.L.Wood et al, Phys, Rep., 215, 3&4 (1992)

Physical Motivation

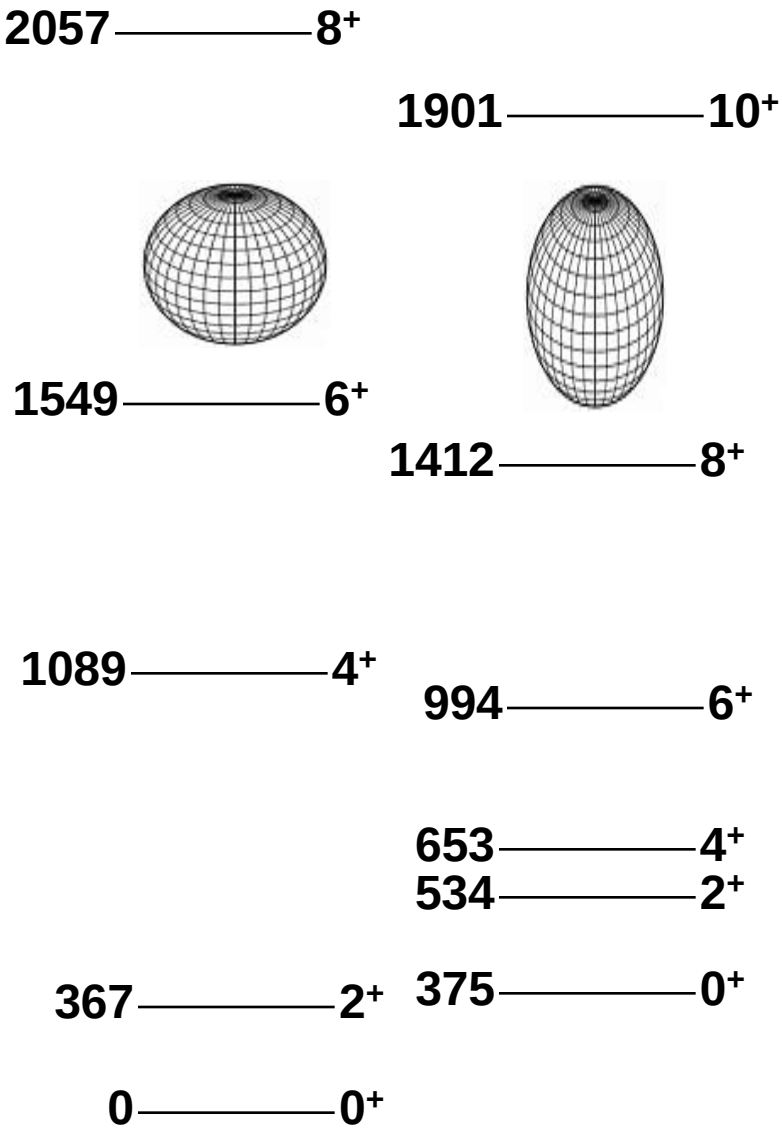


^{184}Hg

shell model: π4p6h states

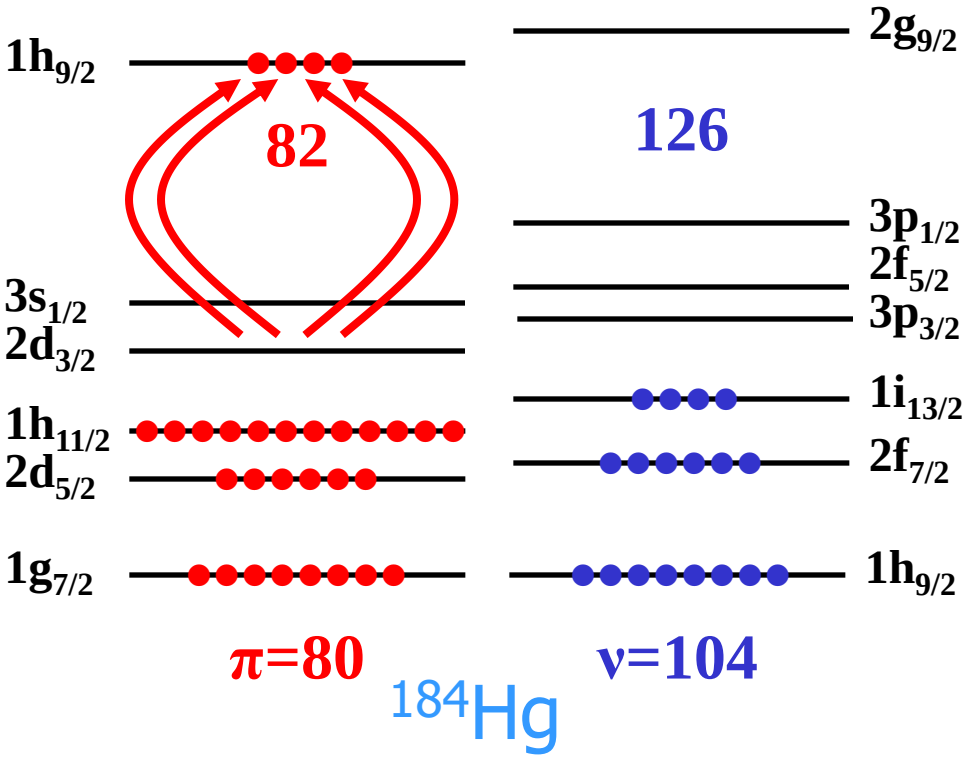
mean-field approximation:

stronger prolate deformation



J.L.Wood et al, Phys, Rep., 215, 3&4 (1992)

Physical Motivation



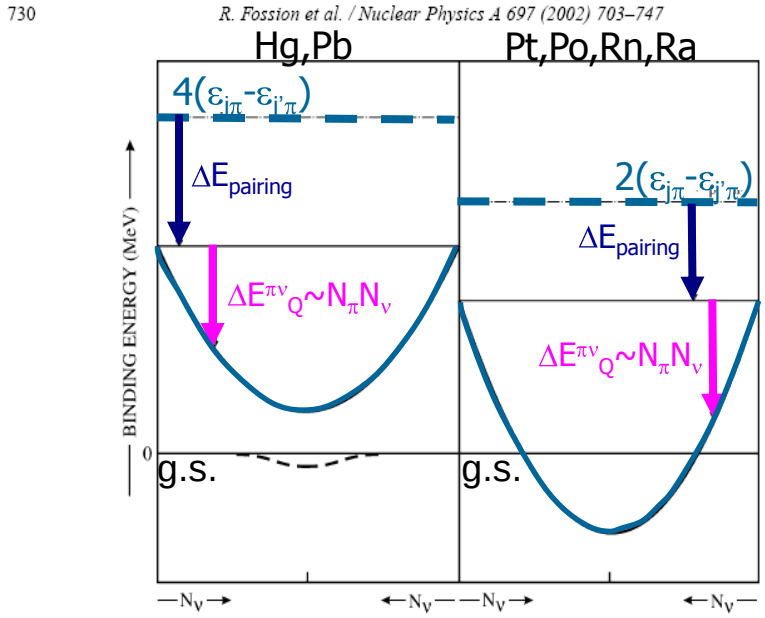


Fig. 13. Schematic representation of the effect of configuration mixing on the binding energy, plotting the different contributions separately. On the left, it is assume that regular and intruder states seat far in energy. On the right, it is assume that the regular and intruder states cross.

$$E^*_{intruder}(4p\text{-}6h) = 4(\varepsilon_{j\pi} - \varepsilon_{j'\pi}) - \Delta E^{\pi\pi}_{pair} + \Delta E^{\pi\nu}_{M} - \Delta E^{\pi\nu}_{Q}$$

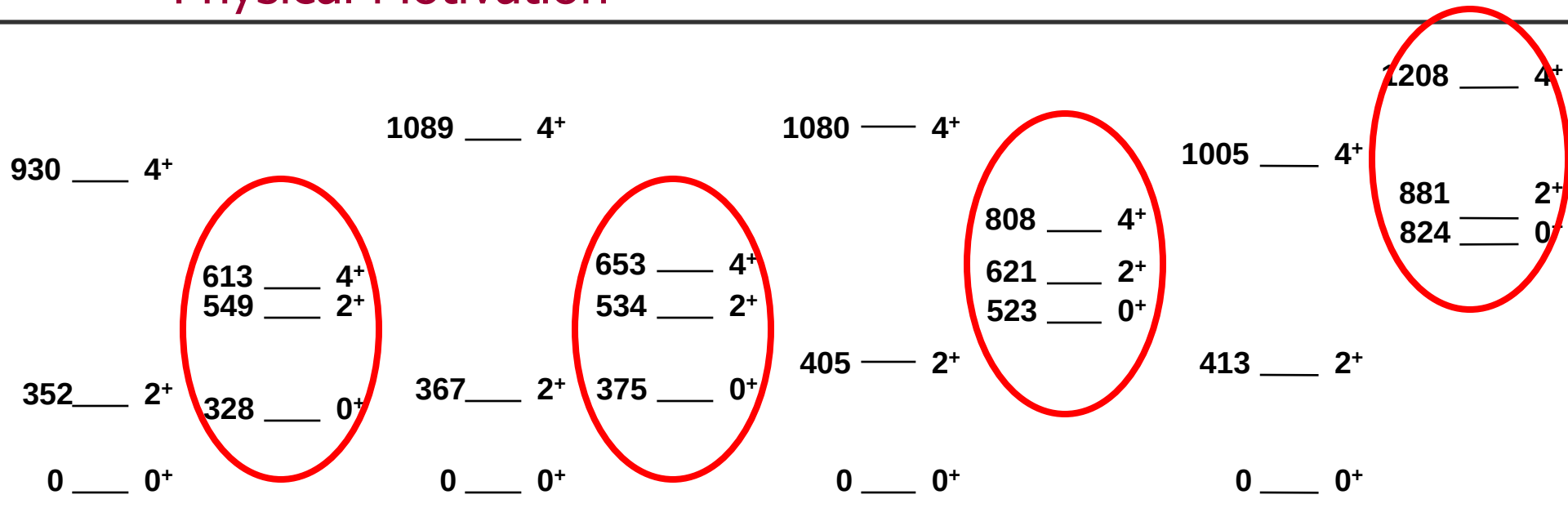
K. Heyde et al, Nucl. Phys. A 466, 189 (1987)

Slightly oblate ground state band

Prolate band

SHAPE COEXISTENCE

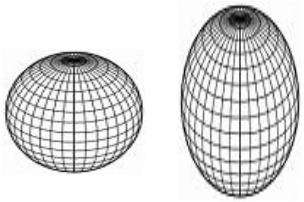
Physical Motivation



^{182}Hg ^{184}Hg ^{186}Hg ^{188}Hg

Ground state band: slightly oblate — deformation $\beta_2 \approx -0.15$

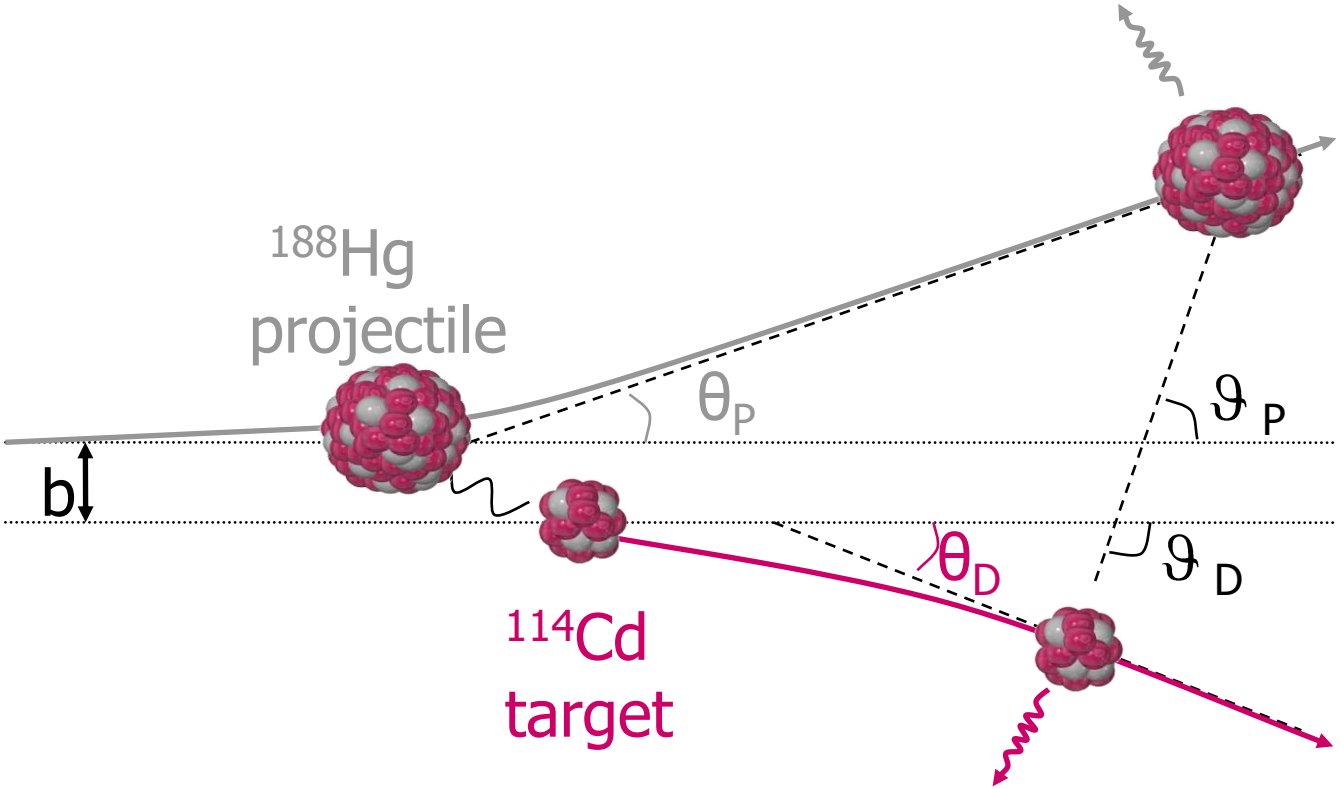
Excited band: prolate — deformation $\beta_2 \approx +0.25$



Coulomb excitation: the transitions observed reveal information on:

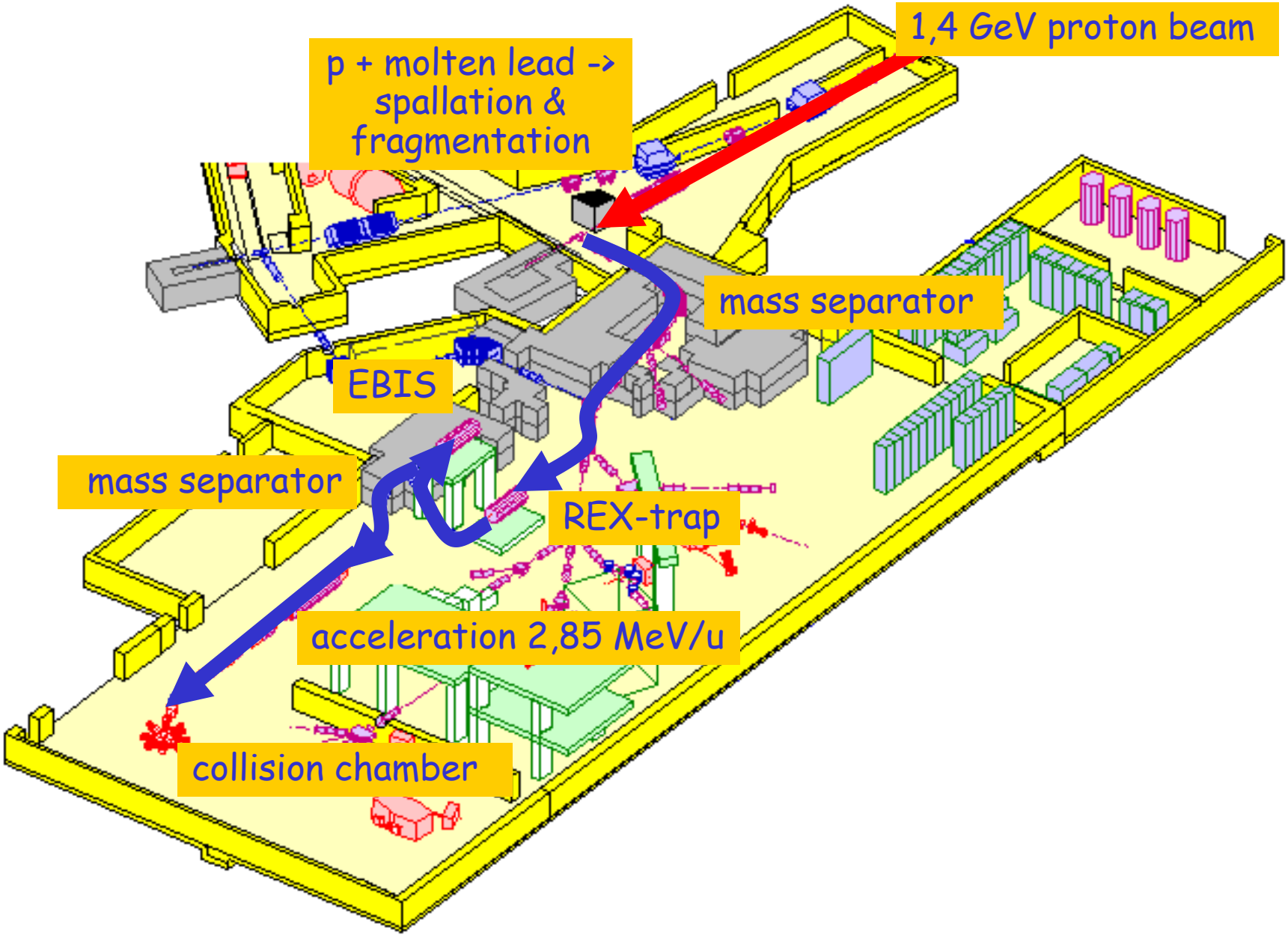
- Mixing between the different bands (transitional matrix elements)
- Information on the deformation (quadrupole moments)

Experimental set-up

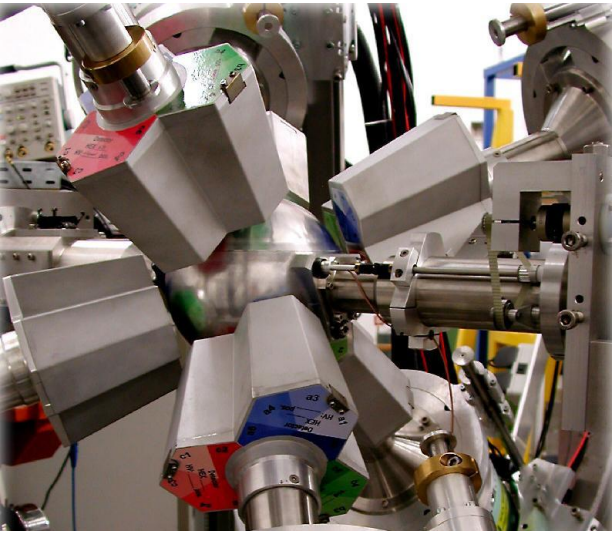


$$B(E2, I_i \rightarrow I_f) = \frac{1}{2I_i + 1} |< I_i \| M(E2) \| I_f >|^2$$

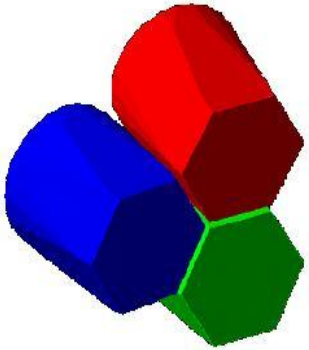
Experimental set-up



Coulomb excitation of ^{182,184,186,188}Hg



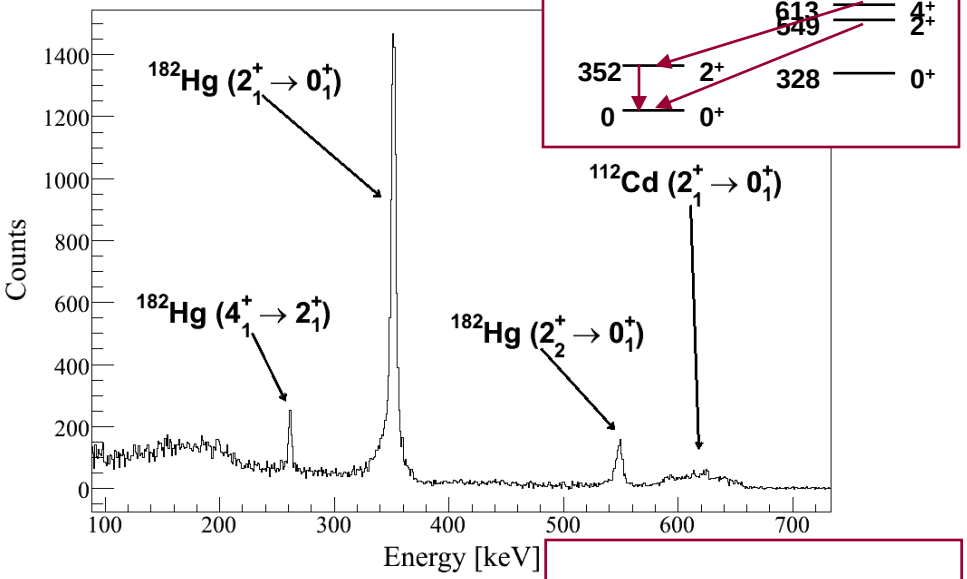
Miniball

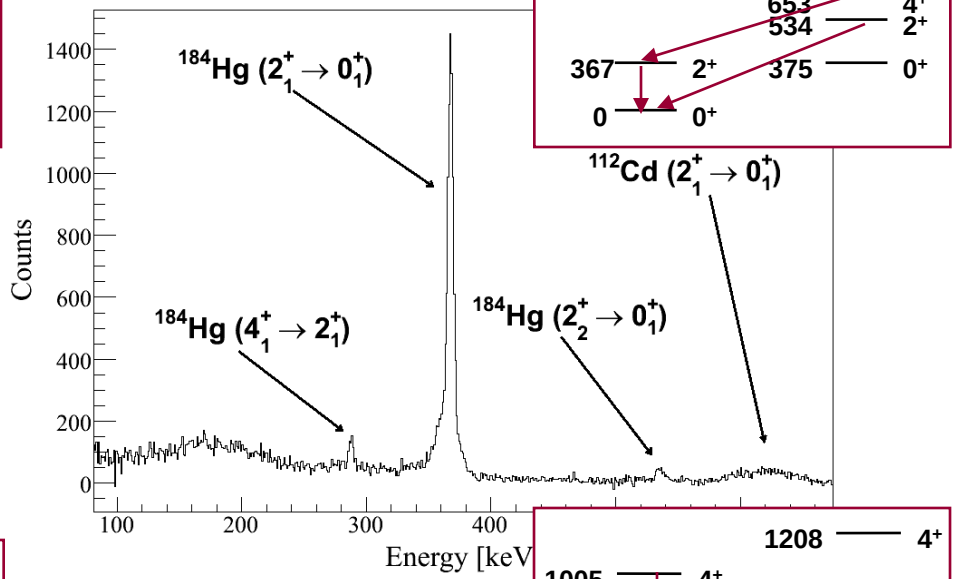


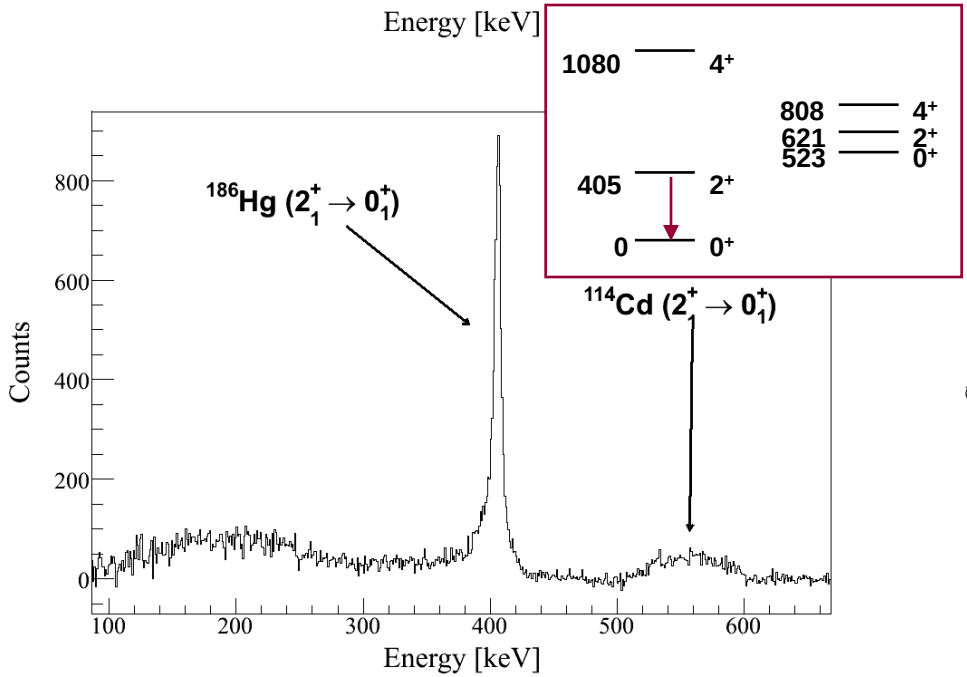
Isotope		Summer 2008
^{182}Hg		4.9 x 10^3 pps
^{184}Hg		1.0 x 10^5 pps
^{186}Hg		2.5 x 10^5 pps
^{188}Hg		3.1 x 10^5 pps

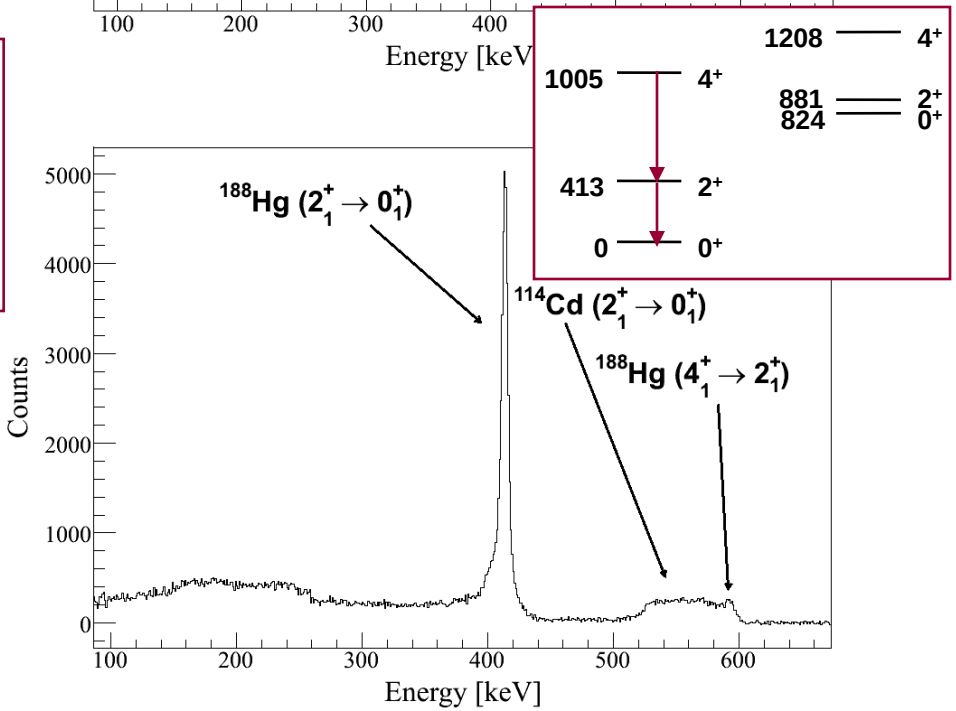
Coulomb excitation of ^{182,184,186,188}Hg

Last summer: 2.85 MeV/u
on ^{112,114}Cd target



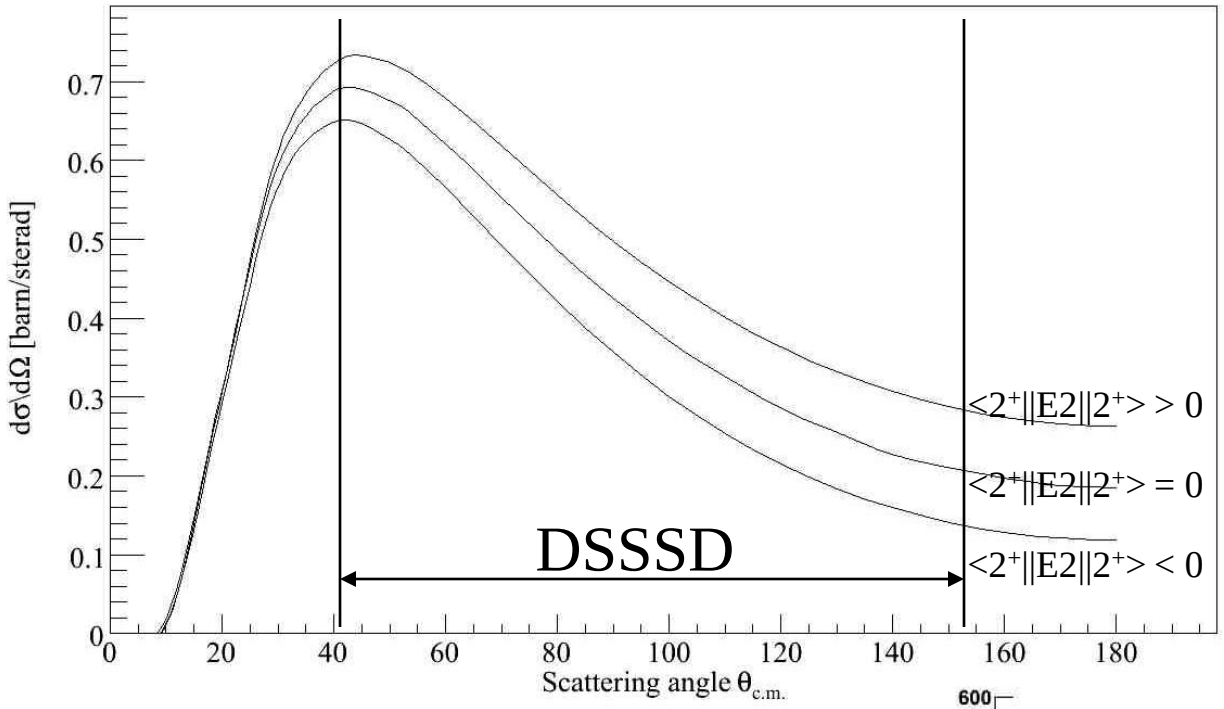


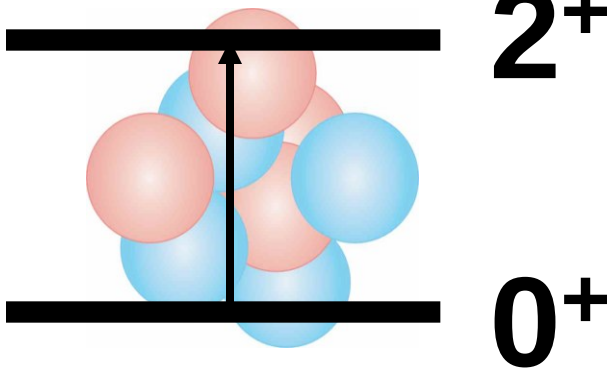




Coulomb excitation of ^{182,184,186,188}Hg

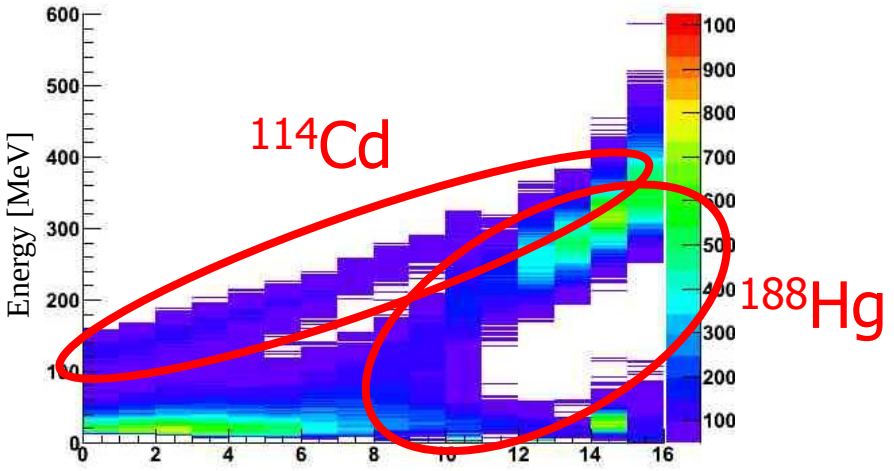
Determination of the quadrupole moment of the first excited 2^+ state





Measured cross-section depends on two parameters: $<0^+||E2||2^+>$ and $<2^+||E2||2^+>$.

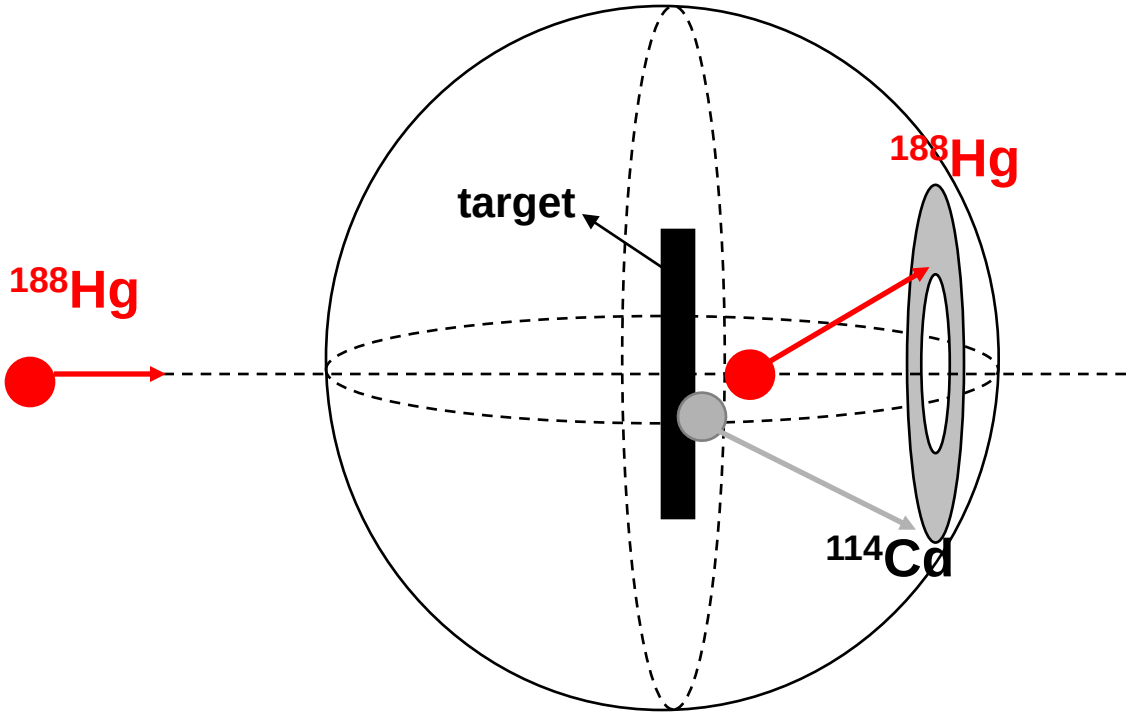
Scanning the c.m. range by gating on different strips!



Coulomb excitation of ^{182,184,186,188}Hg

γ –particle(^{188}Hg)-particle(^{114}Cd) coincidences

- Highly qualitative method to separate projectile and recoil (kinematical matrix picture)
- This is because the kinematics of the reaction are known.



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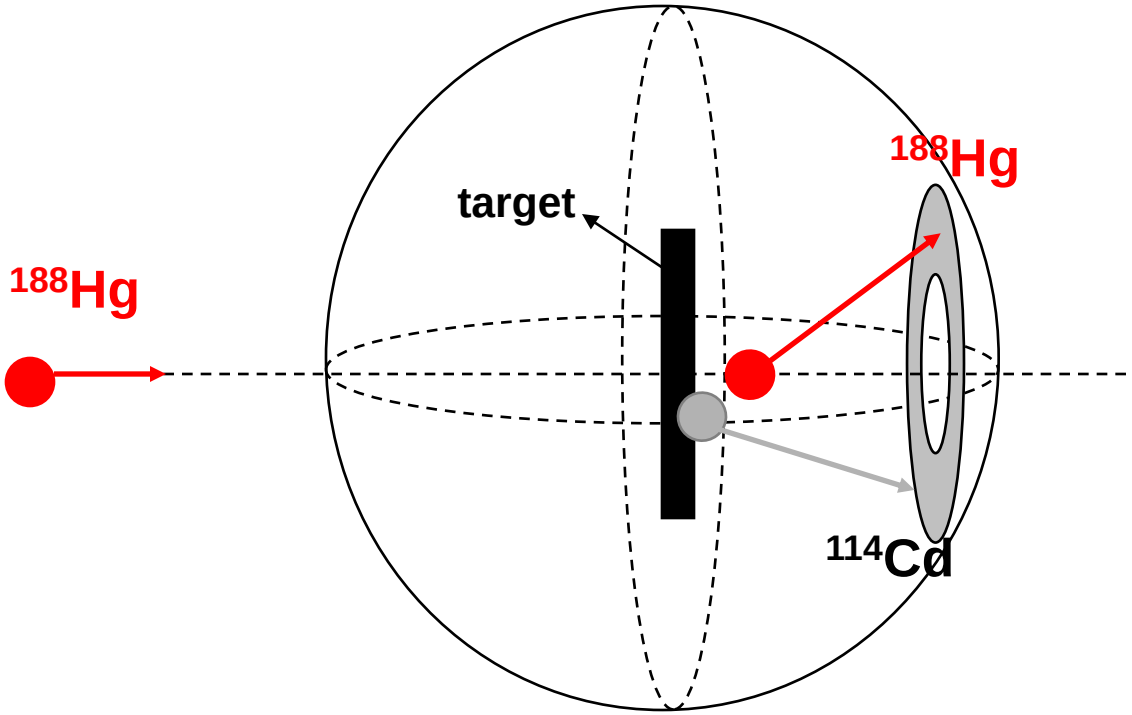
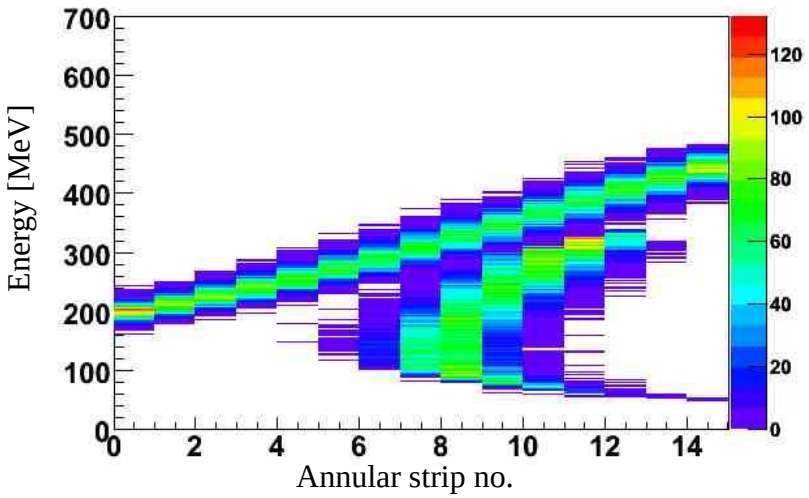


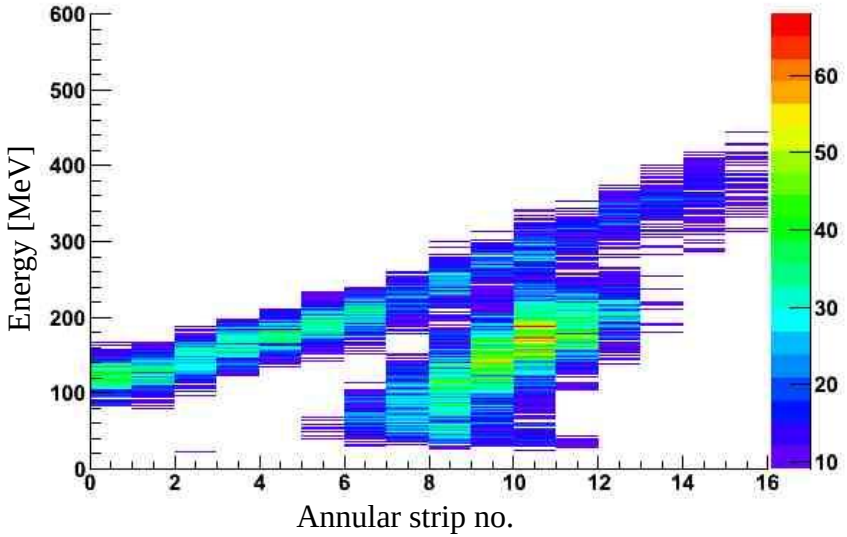
Coulomb excitation of ^{182,184,186,188}Hg

γ –particle(^{188}Hg)-particle(^{114}Cd) coincidences

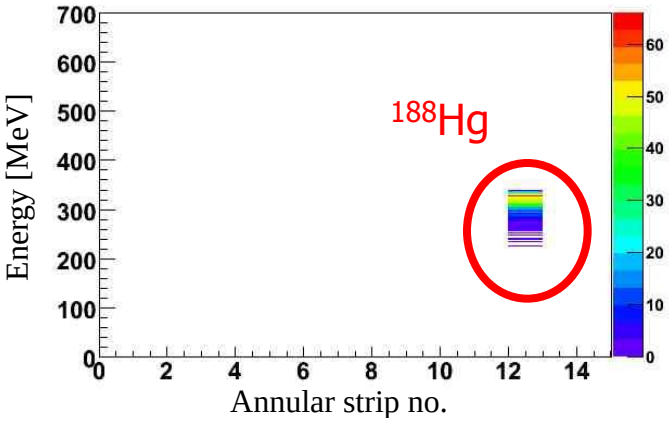
Simulation



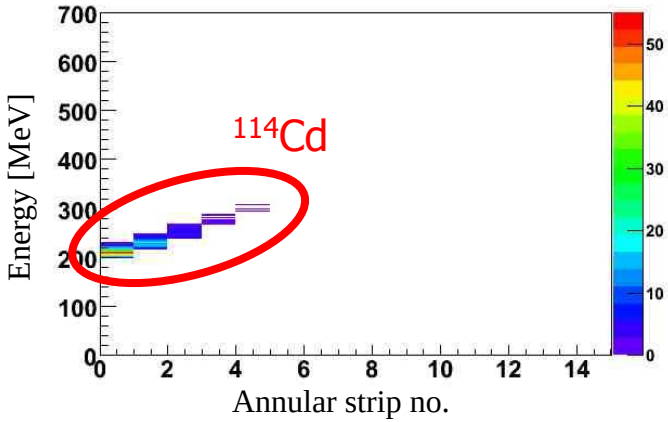
Experiment

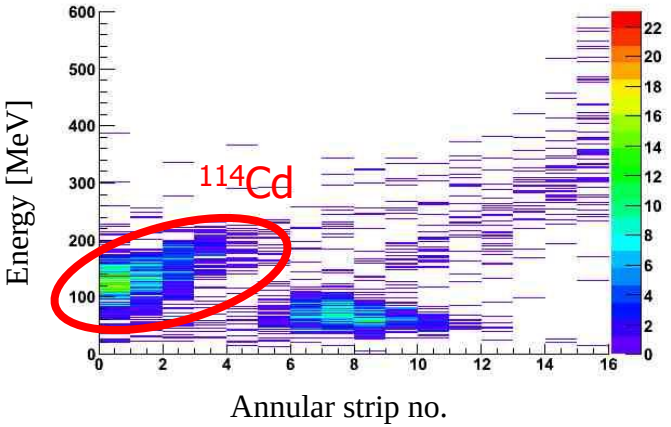


Coulomb excitation of ^{182,184,186,188}Hg

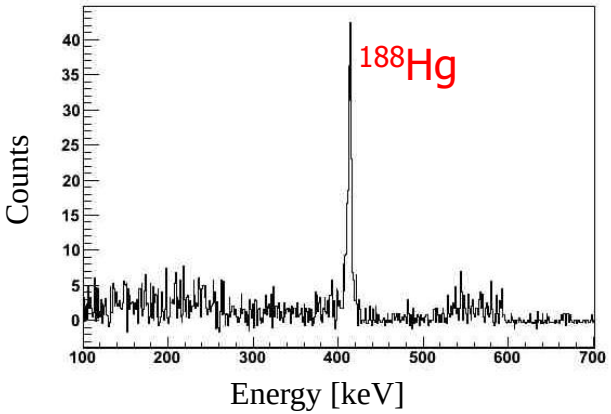


Corresponding ^{188}Hg projectiles and ^{114}Cd recoils from simulation.

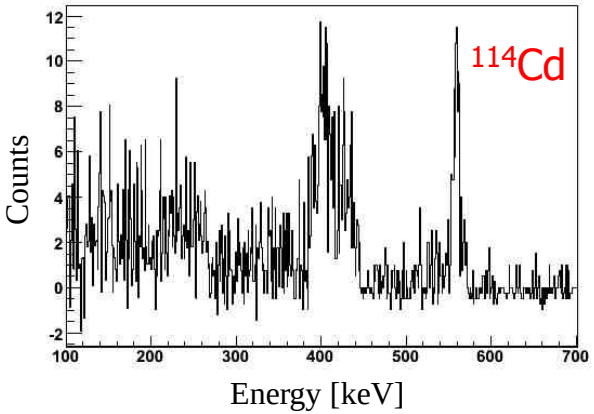




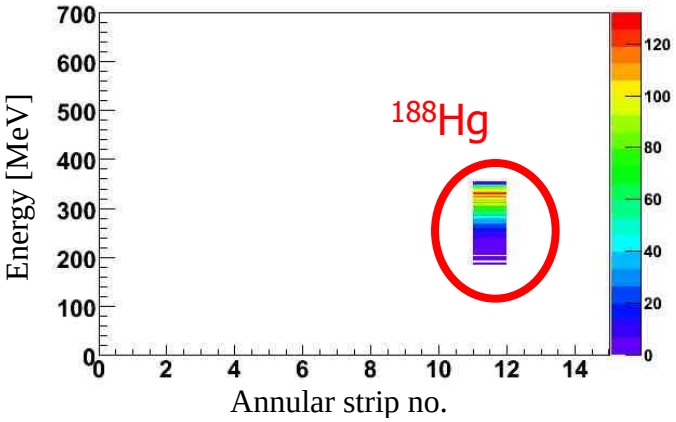
In the experimental spectrum a cut is made to select the physical events.



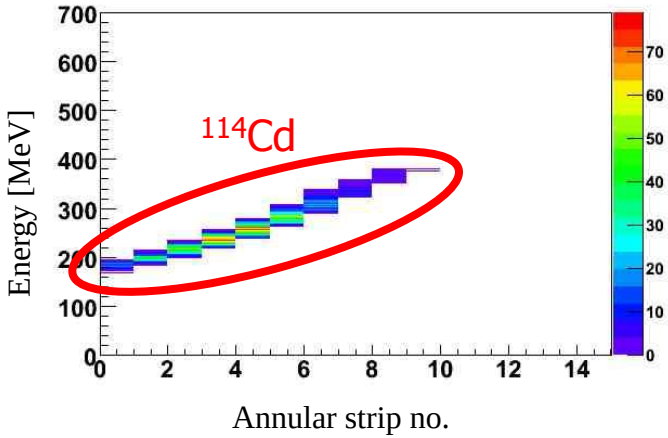
Doppler corrected spectra for the same γ–particle(^{188}Hg)-particle(^{114}Cd) events.

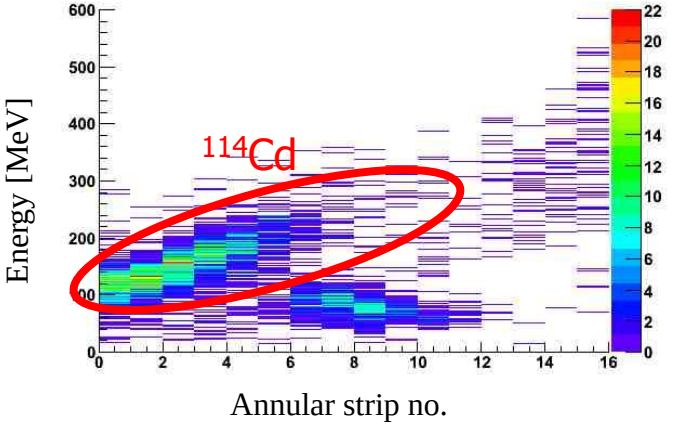


Coulomb excitation of ^{182,184,186,188}Hg



Corresponding ^{188}Hg projectiles and ^{114}Cd recoils from simulation.





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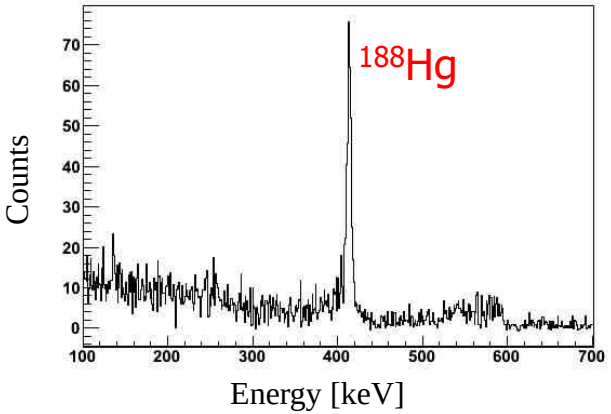
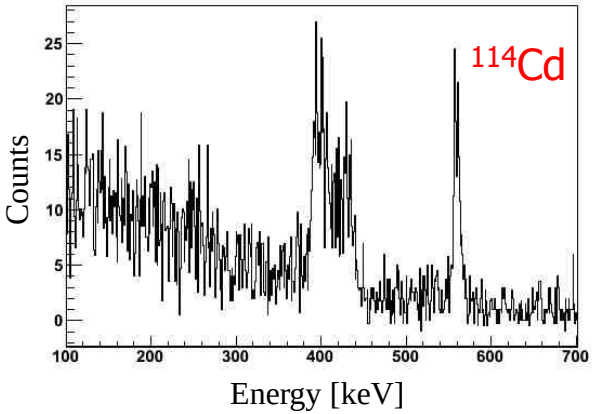
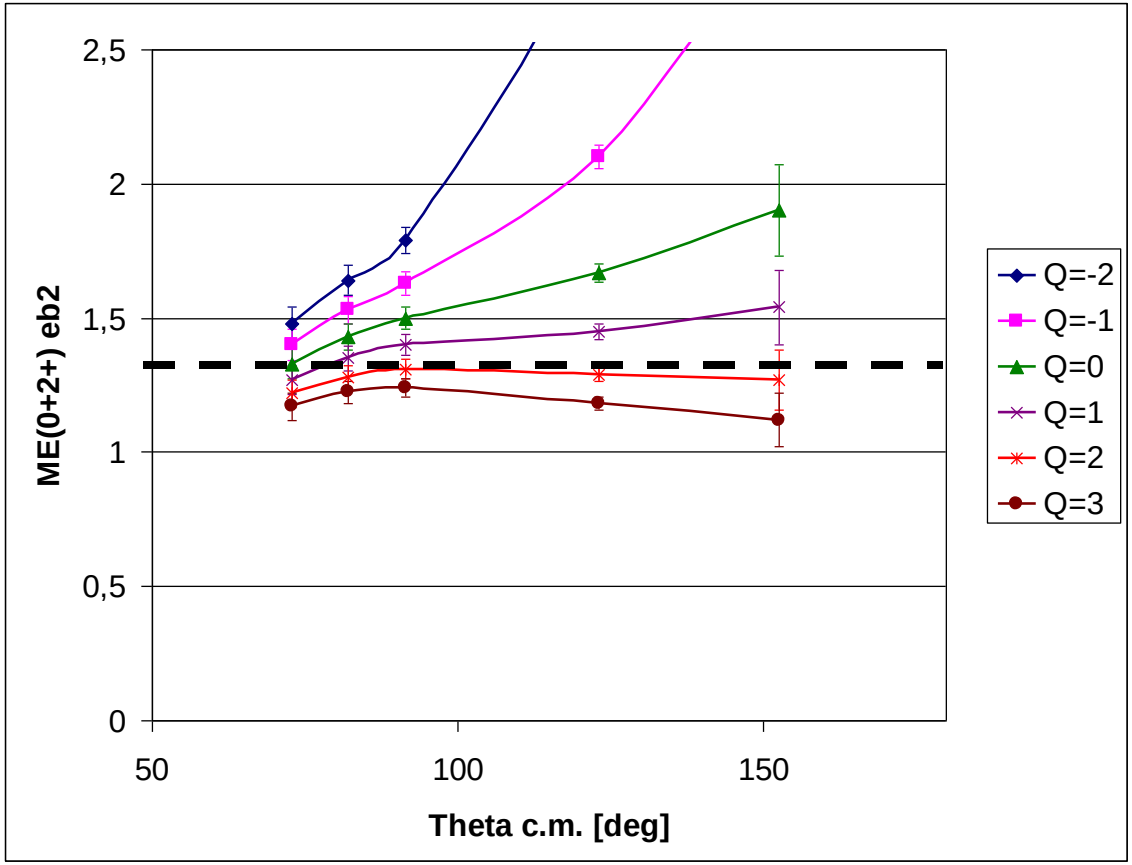


Doppler corrected spectra for the same γ–particle(^{188}Hg)-particle(^{114}Cd) events.



Coulomb excitation of ^{182,184,186,188}Hg

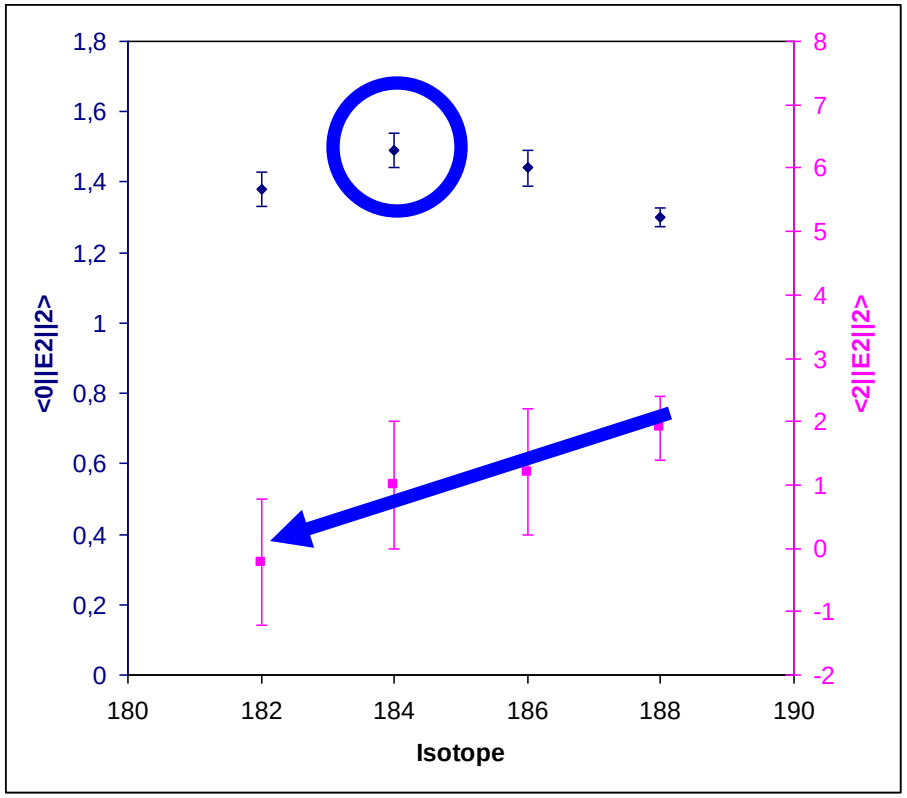


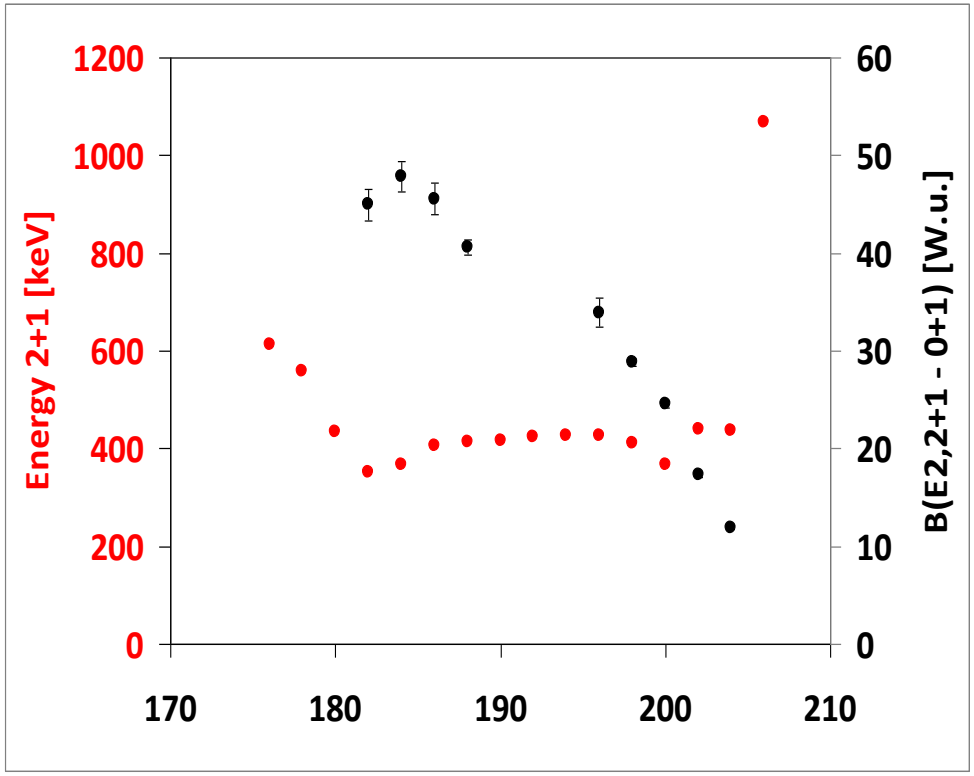
PRELIMINARY!

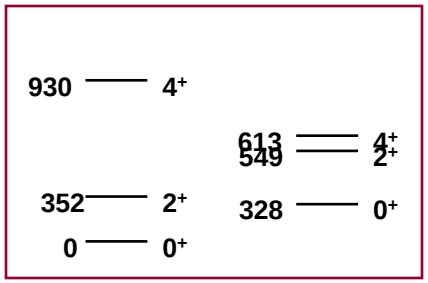
$\langle 2^+_1||E2||2^+_1\rangle \approx 2.0$ eb >> oblate >> deformation $\beta_2 \approx -0.18$

$\langle 0^+||E2||2^+_1\rangle \approx 1.3$ eb

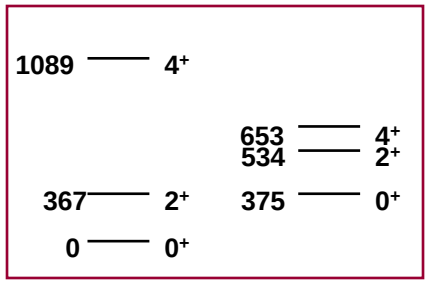
Coulomb excitation of ^{182,184,186,188}Hg



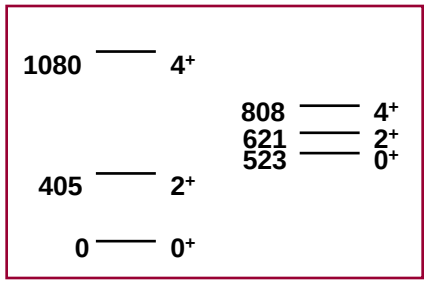




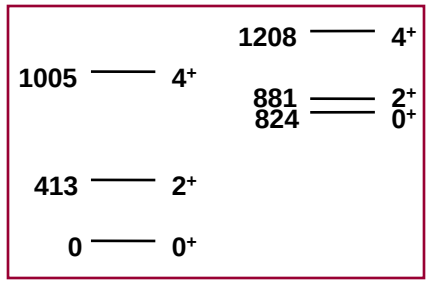
^{182}Hg



^{184}Hg



^{186}Hg



^{188}Hg

Conclusion and future perspectives

- The ongoing analysis shows that diagonal and transitional matrix elements can be extracted.
- The Argonne PAC accepted lifetime measurements to be done on ^{184,186,188}Hg.
- Other Coulomb excitation experiments will take place at REX-ISOLDE in this mass region (e.g. B. Bastin, neutron-deficient Polonium, ^{78,80,82,84}Kr)